

## **SECTION 25 LANDSCAPE IRRIGATION SYSTEMS**

### **PART 1 GENERAL CONDITIONS**

#### **25-1.1 GENERAL**

- A. This work shall consist of furnishing and installing landscape irrigation systems as indicated on the Plans and Specifications and as directed by the Engineer. Due to the scale of the Plans, it is not always possible to indicate all offsets, fittings, etc., which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting the work, and plan the work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Plans are generally diagrammatic and indicative of the work to be installed in the most direct and professional manner, so that conflicts between irrigation systems, planting, and architectural features will be avoided.
- B. The Contractor shall verify and be familiar with the location and size of the existing water supply and shall make approved type connections and install new work. Water meters are to be provided by the City Water Division as shown on the plans.
- C. The Contractor shall verify the correctness of all finish grades within the work area in order to ensure the proper soil coverage (as specified) of the irrigation system pipes.
- D. After the system has been completed, the Contractor shall instruct an authorized representative of the Parks Division in the operation and maintenance of the system and shall furnish a complete set of operating instructions.
- E. The Contractor shall adequately protect the site, and the work, erecting barricades, construction fences, or implementing other protective methods as needed for protection of the job site during both the construction and maintenance period. Replacement and/or repair of any materials, including the labor to effect the work shall be completed at the Contractor's sole cost at no additional cost to the City. The Contractor shall also protect the adjacent property, and the public, from operations or acts that may damage or harm either, and shall be responsible for any damage, injury or loss due to the Contractor's acts or negligence as determined by the City.
- F. The Contractor shall arrange for, secure, and pay for all permits for water service points, meter connections, and fees for water usage during the course of the construction and/or maintenance period until the irrigation work is accepted by the City.
- G. The Contractor shall determine location of underground utilities and perform work in a manner which will avoid possible damage. Call Underground Service Alert (USA)- 1-800-642-2444 at least three days before excavation to secure location of underground utilities. Hand excavate as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned. It is the Contractor's responsibility to verify the location of all on site and off site utilities, either existing or new, and to take appropriate measures to accommodate for all such encounters without extra charge to the City.

### 25-1.2

### DESIGN

- A. The objective of the Plans and Specifications is to provide an assembled and installed landscape irrigation system which will operate in an efficient and satisfactory manner so that the finished system shall efficiently irrigate all areas to be covered and shall prove satisfactory in all aspects to the City. The irrigation system shall be designed in such a manner so that all irrigation will occur between the hours of 10:00 p.m. and 6:00 a.m.
- B. The Contractor shall not willfully install the irrigation facilities as indicated on the Plans when it is obvious in the field that obstructions or grade differences exist that might not have been considered in the design. Such obstructions or differences should be brought to the attention of the Engineer, in writing by the Contractor, for consideration of adjustment in proposed facility locations prior to installation of facilities.
- C. Elevations shown on Plans are not specified in this section. Coordinate all work with the earthwork/rough grading Contractor and the grading and drainage plan in order to arrive at rough grades that will allow tolerance for topsoil (if needed) that will ultimately affect the depth of irrigation piping and the final placement of heads and emitters, as called for on the plans.

### 25-1.3

### TESTS AND INSPECTIONS

- A. Pre-construction Meeting: All Contractor's in the project shall attend this pre-project meeting before beginning construction of the project. **The chief inspector, and managing City division shall be established at the pre-construction meeting.**
- B. Inspections shall be done on an ongoing basis by the various City Divisions involved in the project. Whenever "City of Fresno" is noted within these Specifications it is also construed to imply a duly authorized representative of the City, including inspector's and consultants acting on behalf of the City's interest.

### 25-1.4

### SUBMITTALS

- A. Submit manufacturer's or vendor's certified analysis for valves, fittings, pipe, filters, backflow units, valve boxes, pressure regulators, pumps, and all other materials and equipment as described on the plans, and listed within these Specifications for irrigation materials, parts and/or other products proposed for the job site. Submit other data substantiating that materials comply with specified requirements. Such certificates may be tags, labels, and/or manufacturer's literature, and all **submittals shall be reviewed and stamped as approved by the City of Fresno before Contractor attempts to purchase the materials or begins work on the project. The City will not be responsible for materials and labor expended or secured by the Contractor prior to approval of the submittals.**

Submit 5 copies of submittals to City of Fresno for review.

- B. Submit proposed work schedule, indicating dates for each type of irrigation work during normal seasons for such work in areas of the site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion.

Do not begin work until such schedule is reviewed and stamped as approved by the City of Fresno and returned to the Contractor. Such work schedule, once accepted, may not be revised except for reasons beyond the landscape installer's control. Revised dates only if approved and after documentation of reasons for delays.

- C. Substitutions of materials, equipment, or methods from these given in these Specifications or shown on the Plans shall be accepted in writing by the City of Fresno before delivered to the job site for use. Where the Specifications indicate "or approval equal" the Contractor shall provide the City of Fresno with literature for one or two alternative products for review. All submittals shall be made well before that item of work is scheduled for installation. Multiple copies (5) of the literature shall be supplied for review and acceptance or rejection. Written acceptance for an "approved equal" product by the City of Fresno is required prior to installation. The City of Fresno shall govern as to what name brands and/or substitutes of materials are an "equal" to the specified product on the plans; **This decision shall be final.**

## **25-1.5 PROJECT RECORD DOCUMENTS**

- A. Throughout progress of the work, maintain an accurate record of changes in the Contract Documents.
- B. Promptly, following authorization of construction, designate one complete set of the Contract Documents, to be used only as the "Job Record Set". Do not use the Job Record Set for any purpose other than to record changes occurring in the Contract Documents during progress of the work. Make entries within 24 hours after receipt of information that the change has occurred.
- C. Upon completion of the work, and as a condition of its acceptance, deliver the properly annotated Job Record Set to the City of Fresno for review. From the Job Record Set, an "As-Built" drawing shall be prepared by the Contractor on reproducible mylar on City standard media and submitted to the City before final acceptance of the work. Make entries within 24 hours after receipt of information that the change has been made.
- D. Upon completion of the work, and as a condition of its acceptance, deliver the properly annotated Job Record Set to the City of Fresno for review. The Contractor shall submit the reductions and reproducibles to the City of Fresno before the final inspection.
- E. It shall be the Contractors responsibility to prepare "As-Built" plans which are professionally drafted and approved by the City of Fresno before full acceptance of the project is given by the City of Fresno. Final "As-Built" plans shall be professionally drafted by the Contractor onto reproducible mylar. From the Job Record set, an "As-Built" drawing shall be prepared by the Contractor as follows:
  - 1. One (1) full size reproducible mylar
  - 2. Three sets of full size blueines
  - 3. One (1) reproducible mylar at 50% size of the original

4. One set of the reduced blue lines shall be marked so that each lateral and main irrigation line is delineated with a different color so as to clearly distinguish the individual irrigation lines from one another. This requirement shall not apply to the subsurface irrigation lines. The colored set shall then be laminated by Contractor before delivery to the City.

The originals and copy's shall clearly be marked with the words "As-Built" plans, and marked with the date of preparation.

- 5 .As-Built Dimensions: The Contractor shall dimension from two permanent points of reference the location of the following:
  - a. Isolation valves
  - b. Connections to existing water lines and size connections
  - c. Pressurized main lines
  - d. Pressure relief valves
  - e. Pressure main line connections
  - f. The final routing and location of the pressure mainlines and non pressurized lateral lines under pavement.
  - g. Routing of the control wires
  - h. Automatic flush and air vacuum relief valves
  - i. Quick coupler valves
  - j. "Stub off's" for future use

- F. A coverage test shall be performed on all irrigation area in the presence of the City of Fresno inspector's. Coverage test(s) shall include, but shall not be limited to the testing of spray heads, dripper lines, and other irrigation system components shown on the plan. The Contractor shall furnish all materials and labor required to achieve irrigation coverage acceptable to the City.

## **PART 2 GENERAL CONDITIONS**

### **25-2.1 GENERAL**

**Any material specified by name and/or model number in the Specifications or on the Plans shall be deemed to be used for the purpose of identifying the materials and insuring the specific use of that material in the construction of the system.**

### **25-2.2 MATERIALS**

- A. Piping material used in landscape irrigation systems shall conform to the following requirements:
  1. Mainline Irrigation Pipe: All mainline or pressure supply line plastic pipe shall be standard weight class 315 polyvinyl chloride (PVC)

1120 high impact solvent weld pipe. [Pipe 5cm (2") or less shall be Schedule 40 PVC, solvent weld]. The Contractor is to properly thrust-block all changes of direction in the mainline pipe.

2. Lateral-line Irrigation Pipe: All lateral-line or non-pressure line plastic pipe shall be standard weight class 200 polyvinyl chloride (PVC) 1120 normal impact. All plastic pipe shall conform to current National Sanitation Foundation (NSF), Iron Pipe Size (IPS) standards and American Society for Testing & Materials (ASTM) requirements. Pipe shall be of approved white rigid PVC compound.
3. Pipe Identification: All pipe shall be continuously and permanently marked with the following information:
  - a. Manufacturer's name or trademark
  - b. Nominal pipe size
  - c. Schedule and type of pipe
  - d. Pressure rating in PSI
  - e. NSF seal of approval

B. Plastic Pipe Fittings and Connections: All plastic fittings shall be white rigid PVC combination type I and II, grade I standard weight schedule 40 and/or have a working pressure rating no lower than that of the pipe. The sockets must conform to the outside diameter of the pipe, as recommended by the pipe manufacturer.

1. All plastic fittings and connectors shall be injection molded of an improved PVC compound featuring high tensile strength, high chemical resistance and high impact strength in term of current ASTM standards from such fittings and as manufactured by Lasco Industries or approved equal. Where threads are required in plastic fittings, these shall be injection molded also.
2. Fittings Identification: All fittings shall bear the manufacturer's name or trademark, material designation, size applicable (IPS schedule, and (NSF) seal of approval.
3. Plastic-to-steel Connections: At all PVC pipe to steel pipe connections, the Contractor shall complete the steel connection first. Teflon tape shall be used on all threaded PVC to steel pipe joints applied to the male threads only, and light wrench pressure to be applied. A minimum of three (3) wraps of Teflon tape will be required.

C. Plastic Pipe Cement: Solvent cement joints for plastic pipe and fittings will be made as prescribed by the manufacturer. The high chemical resistance of the pipe and fitting compounds specified in the foregoing

sections makes it mandatory that an aggressive colored primer, which is a true solvent for PVC, be used in conjunction with a solvent cement designed for the fit of pipe and fittings of each size range specified.

- D. Galvanized Pipe: Pipe shall be hot dip galvanized continuous welded, seamless, schedule 40 steel pipe conforming to applicable current ASTM standards.
  - E. Galvanized Fittings: All fittings shall be galvanized malleable iron ground joint Schedule 40 conforming to applicable current ASTM standards.
  - F. Sprinkler Heads: Sprinkler heads shall be of the type and performance as listed in the sprinkler head legend on the Plans.
  - G. Drip Emitters: Drip emitters shall be of the type and performance as listed in the sprinkler head legend on the Plans.
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- 1. Polyethylene Sub-Surface Drip Irrigation Line (SDI): Nominal sized one-half inch low density, linear polyethylene tubing, housing internal pressure compensating, continuously self-flushing, integral drip emitters. The emitters shall continuously clean themselves while in operation. Fittings shall be manufacturers standard barbed as needed to provide connections for the SDI tubing. Compression fittings will not be accepted.
  - 2. All drip irrigation systems shall utilize an automatic line flushing valve at the end of each independent zone or drip line (maximum flow per valve shall not exceed 15 gpm). This valve shall be capable of flushing one gallon of water at the beginning of each irrigation cycle. The valves shall be a Toro CEFCH-H, Agrifim FVA series or approved equal with ½" MPT connection, or other connection as necessary to fit onto the poly or SDI line as needed.
  - 3. Each independent irrigation zone shall utilize an air/vacuum relief valve, as designated on the plans and/or at the irrigation zone's highest point(s). The purpose of the valve is to evacuate air from the zone at start-up, and to relieve vacuum at zone shut down. Air/vacuum relief shall be a Netafim (TLARV), Toro (YD-500-34) or approved equal.
  - 4. The filter type shall be installed as designated on the plans. If not designated, the filter shall be a multiple disc filter sized the same as the valve with color-coded filter elements indicating the mesh size of the element being used. The discs shall be constructed of chemical resistant thermoplastic for corrosion resistance with a minimum mesh size of 140, and a maximum of 180.

5. The tech filter, if specified, shall be installed and sized as designated on the plans. The filter shall be a chemical infused multiple disc filter sized per manufacturers requirements with color-coded filter elements indicating that the filter is infused with herbicide. The discs shall be constructed of chemical resistant thermoplastic for corrosion resistance with an equivalent mesh size of 140. The size of the filter shall be a specified on the plans. If the filter is specified on the plans to be installed near the backflow unit, the Tech filter shall be installed **DOWNSTREAM** of the backflow preventer.
- H. Drip Filters: Filters shall be capable of efficiently removing foreign particles that would clog emitters. Filters shall be a flushable type and contain a replaceable stainless steel element. Filters shall contain a 200 mesh screen as prescribed by the emitter manufacturer. The filter shall be of the type and performances as listed on the Plans.
- I. Remote Control Valves: Electric remote control valves shall be of the type and performance as listed on the Plans.
- J. Control Wiring: Connections between the controller and remote control valves shall be continuous, made with direct burial wire AWG-UF Type, single conductor, installed in accordance with valve manufacturer's wire chart and Specifications, Valve "hot" wire to be no smaller than AWG No. 14. Valve "common" wire to be no smaller than AWG No. 12.
1. All electrical work shall be done in accordance with the governing codes and regulations.
  2. Where more than one wire is placed in a trench, the wiring shall be taped together at intervals of 3 m (10 ft.).
  3. All splices shall be made using waterproof sealing packets. An expansion loop of 50cm (20 in.), minimum, shall be provided at each wire connection and/or directional turn, unless otherwise specified.
  4. Wiring shall occupy the same trench and shall be installed along the same route as the pressure supply lines whenever possible.
  5. All wire splices in field runs will be located in valve boxes, and indicated on "as-built" plans.
  6. A separate common wire shall be installed for each controller.
  7. Control wires will be identified at the controller and at the remote control valve using metal tags stamped with the valve number and

attached to the wire.

- K. Automatic Controller (Electrical, Ambient Leit or Alextronics): Controllers shall be fully automatic in operation, and shall be as specified on the construction plans.
1. Controllers shall be certified by Underwriters' Laboratories and bear their stamp of approval.
  2. Each controller shall have the capacity to operate the amount of valve stations indicated on the Plans.
  3. Controllers shall be of the type and performance as specified on the Plans.
  4. Controllers shall be programmable for various operations as indicated on the Plans, including programmable master valve and pump on/off functions when such equipment is specified.
- L. Gate Valves: Gate valves shall be of the type and performance as specified on the construction plans and of domestic manufacture.
- M. Backflow Prevention Unit: The backflow prevention unit shall be of the type and performance as specified on the construction plans. The backflow prevention unit shall also be approved by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research. The backflow prevention unit shall be of an approved type and be installed downstream to water meters, in a location approved by the Engineer.
1. For all drip irrigation systems, reduce-pressure backflow prevention units shall be installed in accordance with City of Fresno standards.
  2. After being installed at the project site, the backflow prevention unit must be tested and approved as functioning properly by an approved AWWA certified tester within 5 days of installation with the result sent to the City of Fresno Utilities Division. Approval of the backflow prevention unit must precede any final inspection of the irrigation system. Plumbing for the water meter to the backflow preventer shall consist of galvanized pipe and fittings.
- N. Pressure Regulating and Pressure Sustaining Valve: The pressure regulating and pressure sustaining valve shall be of the type and performance as specified on the construction plans and of domestic manufacture.
- O. Booster Pump: Pump shall provide high efficiency, reliability and stable

operating pressures. Pump submittals shall be approved by the Engineer, in writing. Pumps must be UL approved.

1. Minimum control provisions shall incorporate phase failure (low and high voltage) protection, time-delayed start, and low discharge pressure safety and/or flow control circuits.
2. Concrete pump pad shall surround entire mechanical package (all piping and appurtenances) by a minimum of 30 cm (12") in both length and width.
3. Pump shall be installed on elevated pump base constructed of reinforced concrete or fabricated steel; motor base shall be a minimum of 15cm (6") above concrete equipment pad.
4. Welded or grooved steel or brazed/soldered copper tube piping systems shall be provided. Flanged iron piping is not allowed. Threaded connections are allowed only at the interface of threaded mechanical appurtenances.
5. All above-grade piping shall be sized to maintain velocities below 5 ft. per second.
6. Piping shall be isolated from pump through use of bolted flexible couplings or non-rigid grooved couplings so as to allow for minor misalignment and to avoid imposing stress loads on the pump volute or motor frame.
7. Valves shall be 200 PSI rated, lug style, lever operated domestic butterfly valves 6.3cm (2 1/2") or greater or full port, bronze-bodied ball valves 5cm (2") or less.
8. Bypass check valve shall be flanged or wafer-style silent check valve in order to minimize water hammer during pump cycling.
9. Inlet and discharge pressure gauges shall be 5 cm (2") stainless chased, glass faced, liquid filled and installed with gauge cocks (range to be minimum 50% greater than normal operating pressure).

- P. Electrical Pump Control Panel: weather proof enclosure shall have start push button and H-O-A selector switch suitable for a 120/240V, single or 3-phase booster pump. This unit shall be remote-operated by automatic irrigation controllers through the installation of a 24-volt AC relay of sufficient amperage rating for the system.

Q. Valve Box

1. Valve Box: Rectangular or round plastic valve box as manufactured by Carson Industries , Brooks or approved equal. The following plastic valve box sizes shall be utilized when the box is installed in landscape areas:
  - a. Single valves  $\leq 2$ " size w/o filters: #1419-18 with standard 1419-4B non hinged bolt down cover.
  - b. Single valves  $\geq 1$ " size with filters: #1220-12 with standard 1220-4B non hinged bolt down cover (add extensions as necessary to achieve box height needed).
  - c. Automatic flush/air vacuum relief valves: #910-10 with standard 910-4B non hinged bolt down cover.
  - d. Wire splice boxes: #1419-18 with standard 1419-4B non cover.
  - e. Isolation valves: #1419-12 with standard 1419-4B non hinged bolt down cover (add extensions as necessary to achieve box height needed).
  - f. Quick couplers: #1419-12 with standard 1419-4B non hinged bolt down cover (add extensions as necessary to achieve box height needed).
  - g. Valve boxes located in concrete areas such as sidewalks, driveways, concrete parkway strips, and other paved areas shall be manufactured from concrete with concrete lids. Sizes as noted above.
  - h. Contractor shall place one full sized clay or concrete brick under the corner of each rectangular valve box, and minimum of two full sized bricks under each round valve box.
2. Valve Box Cover, Plastic marked "Irrigation Control Valve" with lockable (bolt down) lids. Each valve box lid shall be permanently marked with a metal tag (rigid aluminum, stainless steel, or brass) bolted to the top of the valve box lid with brass or stainless steel nuts/bolts with the final approved valve sequencing/designation. The metal tag shall be minimum 2" X 3" in size. The valve box lids shall be labeled as follows:
  - a. Master automatic control valves for each area: The designation MV

- b. Automatic control valves: The designation ICV followed by the valve sequence as listed on the plan. If a satellite system is specified for the project, the satellite number and sequence that the valve is hooked up to back at the controller shall be labeled on the valve box lid.
- c. Quick Coupler valve: The designation QCV
- d. Automatic flush valves: The designation AFV followed by the automatic valve number that the AFV is attached to .
- e. Air vacuum relief valve: The designation AVR followed by the valve number that the AVR is attached to.
- f. Isolation Valves: The designation ISO/V.
- g. Wire splice box: The designation SPLICE
- h. Unused blank wires shall be marked with the words UNUSED WIRE and terminal location where the wire is hooked up back at the controller.

R. Operations and Maintenance Manuals: Within ten calendar days prior to completion of the construction, the Contractor shall prepare and deliver to the City all required and necessary descriptive material in complete detail and sufficient quantity, properly prepared in two individually bound sets of Operating and Maintenance Manuals. These manuals shall describe the material installed and shall be in sufficient depth to permit operating personnel to understand, operate and maintain all equipment. Spare parts(s) lists and related manufacturer identification shall be included for each installed equipment item. Each complete, bound manual shall also contain the following information:

- 1. Index sheet, stating Contractor's address and telephone number, duration of guarantee period, and list of equipment, with names and addresses of local manufacturer representatives.
- 2. Complete operating and maintenance instructions on all major equipment.

S. The Contractor shall be responsible for correct procedures in loading, unloading, stacking, transporting, and handling all materials to be used in the system. The Contractor shall avoid rough handling which could affect the useful life of equipment. Pipe shall be handled in accordance with the manufacturer's recommendations on loading, unloading and storage.

T. Water Meter: Prior to the beginning of the maintenance period, the Contractor shall contact the City Utilities Division and request the installation of the appropriately sized water meter.

U. A protective steel cage shall be installed in all locations as designated on

the Plans (if designated). The caging shall be constructed to allow space for the entire piping assembly associated with the RPB unit, controller, and all associated equipment. If not called for, the caging shall be as follows:

1. Concrete slab: Class A concrete, min of six (6) inches thick through the entire slab.
2. Enclosure metal: #9 Gauge (171 lbs/SF) expanded metal grating with openings not to exceed 3/4". Metal shall be cut to fit dimensions as necessary, with a continuous weld along the seams and connection points to the metal framing.
3. Steel support bars: 1.5" X 1/8" flat steel bars for vertical isolated structural support, and 1.5" X 1/8" angle iron at all perimeter frame locations. Miter all corners to 90°. All bar intersections shall be welded with 3/8" fillet welds.
4. Locking slot, eye bolt and corner supports: Locking slot shall be .250 inch angle iron slot, bent at 90° angle, and capable of inserting into eye bolt. Eye bolt shall be sized to match locking slot, and shall be of stainless steel (SS) construction, 1.0: dia and a minimum of 3/8". Eye bolt shall be imbedded into concrete slab minimum of 2". Corner anchors shall be 3/8" iron, imbedded a minimum of 2" into the slab.
5. Hinge bolts: 1 1/2 " long and 1/2 " dia SS bolts with associated SS nut and washers.
6. Address plate: Two 3" by 8" address plates shall be mounted on two locations of the controller cage in the upper right hand location. One plate shall be located on the short section of the cage, and one plate on the long section of the cage. Plate shall be manufactured of 1/8" steel plating, and welded with continuous bead into the angle iron support. The water meter address shall be placed onto one of the address plates. The numbers shall be consist of 1"high, adhesive backed, and weather, reflective material.

- V. A commercially manufactured insulating blanket shall be placed around the backflow preventer assembly to protect the unit from freezing. The blanket shall extend over all piping, the RPB unit, hose bibs, pressure gauges, and all other equipment above ground associated with the RPB. The controller housing shall not be included in blanket if the controller is an ambient light powered unit. The insulating blanket shall be manufactured by Hydro Peripherals (Polar Parka), World Wide Canvas (Backflow Blanket) or approved equal.

## **PART 3 EXECUTION**

### **25-3.1 TRENCHING**

- A. Excavations shall be open vertical construction, sufficiently wide to provide free working space around the work installed and to provide ample space for backfilling and tamping.
- B. The use of a vibratory plow or methods other than open vertical trenching will not be allowed without the written approval of the Engineer. To obtain such approval, a field test must be performed, at the proposed site, with the equipment to be used in the presence of the Engineer. The field test is to indicate if the proposed site is favorable to the plowing method. Approval for plowing at one location does not allow the use of plowing at another location. Approval for plowing must be obtained for each location where the use of plowing is proposed. If, at previously approved plowing locations, conditions for plowing become unfavorable as determined by the Engineer, plowing shall be terminated.
- C. Trenches for pipe and equipment shall be cut to required grade lines, and compacted to provide an accurate grade and uniform bearing for the full length of the line.
- D. When two pipes are to be placed in the same trench, a minimum 10 cm (4") space between pipes must be maintained.
- E. The depth of the trenches shall be sufficient to provide a minimum cover above the top of the pipe as follows:
  - 1. 60cm (24") minimum over main lines
  - 2. 45cm (18") minimum over non-pressure (rotary pop-up) lateral lines.
  - 3. 30cm (12") minimum over non-pressure (pop-up spray head) lateral lines.
  - 4. 60cm (24") minimum over lines located in paved areas.

### **25-3.2 INSTALLATION**

- A. Water Supply: The Contractor shall connect to water supply line as indicated on the Plans. Connections to the existing water supply shall be made at approximately the location shown on the Plans. Minor changes caused by actual site conditions may be required.
- B. Layout: The Contractor shall be responsible for layout of proposed facilities and any minor adjustments required due to differences between the site and Plans. Any such deviations in layout shall be within the intent of the original Plans. The City will indicate the proposed precise location of the control panels.
- C. Grades: Before starting work on the system, the Contractor shall carefully check all grades to ensure the work may safely proceed and keep within the specified material depth. If the slope of the landscaped area exceeds 5%, inline check valves shall be installed at each sprinkler subject to low head drainage.

- D. Standard of Installation: Material and workmanship shall be in accordance with local codes and ordinances of legally constituted authorities; except where provisions of these Specifications exceed such requirements, these Specifications shall govern.
- E. General Installation: Any equipment installed by the Contractor and deemed to be for the use of the City in various situations (i.e., control valves, control panels, etc.) shall be so installed to be readily accessible and quickly operable. Two keys for lockable equipment shall be supplied to the City upon installation. Equipment deemed by the City to be inoperable for its intended purpose shall be reinstalled by the Contractor in an operable position before approval will be given. Routing of pressure supply lines as indicated on the Plans is diagrammatic. Install lines (and various assemblies) in such a manner as to conform to details on plans.
- F. Assemblies: Install all assemblies specified herein according to the respective detail Plans or Specifications pertaining to specific items required to complete the work. Perform work according to best standard practice, with prior approval.
1. Install no multiple assemblies on plastic lines. Provide each assembly with its own outlet.
  2. All brass pipe and fittings shall be assembled using Teflon tape, or equivalent, applied to the male threads only. A minimum of three (3) wraps of Teflon tape will be required.
  3. All plastic and galvanized steel threaded pipe and fittings shall be assembled using Teflon tape applied to the male threads only. A minimum of three (3) wraps of Teflon tape will be required.
- G. Line Clearance: All lines shall have a minimum clearance of 10cm (4") from each other and 15cm (6") from lines of other trades. Parallel lines shall not be installed directly over one another.
- H. Plastic to Steel Connections: At all PVC pipe connections, the Contractor shall complete the steel connections first. Connections shall always be plastic into steel, never steel into plastic. Teflon tape shall be used on all threaded PVC to steel pipe joints, applied to male threads only, and light wrench pressure is to be applied.
- I. Pipe and Fittings, Galvanized Steel Pipe: All pipe shall be reamed and rough edges or burrs removed so that a smooth and unobstructed flow can be obtained.
1. Reducing fittings shall be used where any change in pipe size occurs. Bushings shall not be used unless specifically authorized by the City. No fitting shall be joined closer than 15cm (6" unless authorized by the City).
  2. Teflon tape shall be best quality, and shall be carefully and smoothly placed on the male threads only. All threaded joints must be tightened with wrenches. No caulking or joint compound

of any kind will be permitted.

3. Immediately upon installation of lines, all openings shall be capped or plugged to prevent the entrance of materials that would obstruct the pipe. Caps shall remain in place until removal is necessary for completion of installation.
4. Thrust blocks shall be installed recommended by the pipe manufacturer, or as shown on the detail Plans.
5. All mainline and lateral pipe traversing paved concrete or hardscaped areas is to be installed in schedule 40 galvanized sleeves that are at least 5 cm(2") sizes larger than the pipe within the sleeve. Also all wire is to be sleeved in schedule 40 PVC pipe that allows a generous amount of room for the wires present and allows for pulling additional wire in the future.

J. Joining of Pipe: It is the responsibility of the Contractor to be familiar with any and all methods of assembling, joining, and installation of the various types of pipe to be used. The Contractor shall strictly adhere to recommendations in the manufacturer's guide. If during any phase of the work, the Contractor or any of the workers are not familiar with the recommended procedures, the Contractor shall arrange with the manufacturer of the particular product for the services of a qualified manufacturer's representative to instruct the workers in the proper recommended procedures.

K. Plastic Pipe: The Contractor shall exercise care in handling, loading, unloading, and storing plastic pipe and fittings. All plastic pipe and fittings shall be stored under a weatherproof roofed structure before using and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lie flat so as to avoid undue bending or concentrated external load at any point.

1. All lumber, rubbish, and rocks shall be removed from the trenches by the Contractor. Pipe shall have a firm uniform bearing for the entire length of each pipe line to prevent uneven settlement. Wedging or blocking under riser tees shall be done only if specified on the plans. Pad trenches with soil as necessary to provide uniform bearing surfaces.
2. Where extensive lengths of pipe are installed, snake pipe in trench from side to side to allow for expansion and contraction. 30cm per 30m (1"per 100') of pipe is the minimum allowance for snaking. Never lay pipe when there is water in the trench or when the temperature is O.C. (32°F) or below.
3. All changes in the direction of the pipe shall be made with fittings, not by bending.
4. Make solvent joints with a non-synthetic bristle brush in the following sequence.
  - a. Make sure pipe is cut square and all connecting surfaces

are properly cleaned and dry.

- b. Apply an even coat of colored primer to pipe prior to application of solvent.
- c. Apply an even coat of solvent to the inside of the fitting.
- d. Apply a liberal, even coat of solvent to the outside of the pipe, making sure that the coat area is equal to the depth of the fitting socket.
- e. Insert the pipe quickly into the fitting and turn the pipe approximately one-quarter turn to distribute the solvent and remove air bubbles. Hold the joint for approximately fifteen seconds so the fittings do not push off the pipe.
- f. Using a clean rag, wipe off all excess solvent to prevent weakening at the joint.
- g. Exercise care of going to the next joint so that the pipe is not twisted, thereby disturbing the last completed joint.
- h. Allow at least fifteen minutes setup time for each welded joint before moving.
- i. Repair damaged plastic pipe by replacing the damaged segment.

L. Backflow Prevention Devices: Backflow prevention devices will be installed in a protective cage. The cage will be constructed of 3/16 inch angle steel frame, with No. 9 expanded steel fabric welded to the frame at each point of contact between the fabric and the frame. The enclosure will include provisions for padlocking, and handles for lifting.

1. For pressure vacuum breakers or atmospheric backflow preventers, a single hinged cage is sufficient.
2. For double-check or reduced-pressure devices, a double hinged cage that opens from the middle is required.
3. The dimensions of the cage will vary depending on the size and type of device required. Consult the enclosed manufacturer's Specifications to determine the appropriate model number. A minimum of 15cm (6") clearance is required between the device and the cage.

M. Control Wiring: Lay the wiring from the remote control valves to the controller. Lay alongside the supply mains where practical. Tape wires together at 3m (10ft) intervals. All wiring passing under existing or future paved walks and roads shall be installed inside PVC Schedule 40 Type II pipe sleeve, a of adequate sizes to permit convenient threading of all bundles, as shown on the plans. Wires shall not be taped together inside conduits. The conduit shall extend at least 30 com (12") beyond the edges of the paved walks or road.

1. Wire sizes shall be determined by the number of valves operating on a given wire and the distance from the controller to the farthest valve, as specified by the charts furnished by the remote control valve manufacturer. Valve wire may be any color other than white. No splices are permitted. Common ground wire must be white and splices are permitted only at remote control valves.
  2. Each remote control valve is to have a dedicated individual 14 GA direct burial wire that is continuous in length to the automatic controller. The common wire is to be 12 GA direct burial and is to be dedicated to the controller it serves. No cross connection of common wires between different controllers will be allowed.
- N. Valve Boxes: Carston Industries, Brooks or approved equal, valve boxes shall be set to finished grade.
1. Remote control valves shall be connected and aligned to provide the most efficient flow of water to the irrigation heads. Each valve is to be enclosed in the specified valve box. The valve box shall be secured on firm soil clear of valves and wiring connections.
  2. Backfill carefully to prevent settlement and subsequent damage. Each valve box corner is to be set on a brick to prevent settling, with a minimum of .3 m<sup>3</sup> (one cubic foot) of pea gravel installed below the valve.
- O. Remote Control Valves: Remote control valves shall be adjusted so that all heads operate within the pressure range recommended by the head manufacturer. Remote control valves shall be adjusted so a uniform distribution of water is applied by the heads to the planting areas for each individual valve system. Make all connections for operation.
- P. Flushing of Lines: After all new piping is in place and connected, and all necessary diversion work has been completed, the control valves shall be opened and a full head of water used to flush out the system.
- Q. Pressure Test: The Contractor shall notify all necessary parties 48 hours prior to pressure testing.
1. The Contractor is to center load pipe with small amounts of backfill to prevent arching or slipping of pipe under pressure.
  2. All solvent welded pipe joints shall be allowed to set at least 24 hours before any pressure testing can be performed.
  3. All pressure lines shall be tested under hydrostatic pressure of (125psi) after installation. The Contractor shall provide all equipment for such tests. Pressure tests will not be required for non pressure lateral lines with swing joints.
  4. Pressure shall be sustained in the lines for not less than four (4) hours. If leaks develop, the joints shall be replaced and the tests

repeated until the entire system is proven watertight.

5. Tests shall be observed and approved by the City Inspector prior to backfill. If irrigation lines are plowed into place, all pipe joints are to be exposed for the pressure test.
6. Upon completion of each phase of the work, the Contractor shall check and adjust each sprinkler head to meet the site requirements and plan.

R. Automatic Controllers: Locate controllers in general locations shown, with exact placement to be determined at the job site by the City's representative.

1. Connect to 120 volt source(s) provided at the site. Install electrical service pedestal at the connection.
2. Use rigid metal conduit above grade, slab, or floor.
3. Provide and install rechargeable battery backup in controllers per manufacturer's recommendations.
4. Connect control wires to controllers in sequential arrangement according to assigned identification numbers on Plans.
5. Controllers shall be properly grounded per Article 250 a of the National Electric Code and conform to local regulations.
6. Controllers shall be programmed so as not to apply excess water. Care shall be taken to prevent runoff and slope/soil erosion caused by prolonged applications of water.

**Note: Contractor will be cited and fined for water waste in accordance with Fresno Municipal Code.**

7. Solar and battery powered controllers shall be installed per manufacturer's recommendation and as directed by the City Inspector.

S. Automatic Controller Schedule: Install automatic controller schedule in laminated plastic or a watertight plastic envelope inside controller cover showing which valves are connected to which stations on controller.

T. Controller Charts: The Contractor shall provide one controller chart for each controller supplied.

1. The chart shall show the area controlled by automatic controller and shall be the maximum size controller door will allow.
2. The chart may be a reduced drawing of the actual "As-Built" system. However, in the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a size that will be legible when reduced.

U. Electrical and Lighting Systems: The Contractor shall be responsible for providing an electrical service in a service panel approved by the Engineer. Power will be provided to the irrigation controller, booster pump (if required), lighting system, or any other electrical component as described on the plans. All circuits will be identified at the service panel.

1. All electrical work shall conform to local codes, ordinances, and regulations.
2. Wires shall not be taped together inside conduits.
3. Lighting systems installed as a component of a landscape design shall conform to all design and materials Specifications on the plans.
4. Unless otherwise noted on the plans, security lights along roadways, alleys, walkways, and in parking areas are to be controlled by a single photo cell, which is to be installed at the control panel and according to manufacturer's recommendations. For most installations, the photo cell should be installed facing north.
5. For maintenance purposes, a test switch that bypasses the photo cell is to be installed in the control panel. The switch is to be identified as the "test". All lighting is to be installed using both time clock and photo cell controls. In larger parks, the security lighting system may be split, having some lights controlled strictly by photo cell and some by time clock/photo cell. Installation shall follow the plans for the specific system design Specifications.
6. Ornamental or landscape lighting (including low voltage systems) shall be installed using a time clock/photo cell control. These lights are required to have relay switches that are separate from the security lighting system.
7. Electrical outlets located at picnic areas or at the base of light poles are to be "hot" at all times. No more than two double-outlet receptacles are to be on a single 30-amp circuit.
8. Each of the above, as well as any other components of electrical/lighting system are to have individual, labeled circuit breakers (i.e. irrigation controller is **not to share a breaker with security** lighting).

V. Sprinkler Heads: Sprinkler heads located in areas where ground cover planting is indicated shall be set on permanent risers with top of head located above finished grade per detail, rotary pop-up sprinkler heads adjacent to walks or roads shall be set 15cm (6") from edge of walk or road, and pop-up spray heads adjacent to walks or roads shall be set 5cm (2") from edge of walk or roads.

1. Upon completion of the installation, the Contractor shall adjust sprinkler heads to properly distribute water flow and shall place entire irrigation system in correct operating condition.

2. Adjust sprinkler heads that spray toward fences or walls so that water spray does not contact side of buildings.
- W. Drip Emitters: Upon completion of the installation, the Contractor shall adjust the drip emitters to properly distribute water flow and shall place entire irrigation system in correct operating condition.
- X. Cathodic (Insulation) Protection: Protection shall be installed as follows:
1. Between wrapped galvanized steel pipe and unwrapped galvanized steel or cast iron pipe in ground using couplings or flanges.
  2. Between pipes and equipment, except at sprinkler heads and backflow preventer.
  3. Between old and new steel piping.
  4. Wherever brass, copper, or bronze is installed in contact with or adjacent to steel buried in the ground, and also at insulated fittings, junction shall be wrapped with minimum of two overlapping layers of specified tape. Tape shall follow the contours of the junction and extend 15cm (6") or more over the steel and over the brass fittings or valve as far as practical.
  5. Galvanized steel pipe under a concrete slab.
- Y. Concrete Equipment Pads: Concrete pads will be provided for all irrigation and electrical equipment in a location approved by the City Inspector. All pads will be installed at finished grade and will be minimum of 6" thick. All pads shall be installed with the slab extending 1.27cm (1/2") above finish grade. All pads shall be sloped to drain to matching drainage patterns at 0.635cm per 0.3m (1/4" per foot). Unless otherwise directed by the City Inspector, the installer will locate the irrigation controller, backflow preventer, and electrical service panel on a common pad.

### **25-3.3 BACKFILL AND COMPACTION**

- A. Backfill shall not be placed until the installed system has been inspected and approved by the City.
1. Backfill material shall be approved soil. Unsuitable material, such as pipe remnants, wire, clods and rocks over 5cm (2") in size, shall be removed from the premises and disposed of legally. Backfill for the first 15cm (6") around the mainline pipe and control wires shall be native soil.
  2. All backfilling shall be done carefully and shall be properly tamped. All soil shall be tamped and jetted to eliminate any voids.
  3. Surplus earth remaining after backfilling shall be disposed of as directed by the City Inspector.

4. Backfilling for all pipe shall be carried out in two basic stages:
  - a. Stage One - Backfilling  
This shall be accomplished as soon as possible after the pipe is laid. A bedding of uniform depth with no voids must be provided along the entire length of the pipe. The bedding dirt should be placed in the trench and tamped into the areas under the pipe, using a suitable tool. Joints should be left exposed until hydrostatic tests are completed. Cover only those portions of the pipe necessary to prevent movement or damage.
  - b. Stage Two - Backfilling  
This shall be completed after all hydrostatic tests are completed and the piping system has been thoroughly checked for leaks or other defects. Continue to add backfill soil in 10cm (4") layers and hand tamp to achieve a density similar to adjacent soil. After 30cm (12") in main line trenches of hand-tamped soil is in place over the pipe and fittings, backfilling can be continued, using light machinery to place dirt in the trenches in 15cm (6") layers and to compact the dirt to conform to adjacent soil. Extreme care should be taken to avoid damage to the pipe from machinery that is too heavy. All trenches shall be water-jetted to assure uniform settling and compaction. Backfilling operations will not be considered complete until the top surface has been graded to conform to the adjacent soil. All rocks must be collected and removed from the site.
5. PVC piping and fittings shall not be backfilled during periods of extreme heat or when a sudden lowering of the temperature of the pipe may cause separation of joints or fittings.

## **PART 4 INSPECTION AND TESTS**

### **25-4.1 PERIODIC INSPECTIONS**

- A. Periodic inspections shall be required for basic operations and installations during progression of the project. It shall be the Contractor's obligation to call and schedule inspections. Such inspections will include but not necessarily be limited to the following items:
  1. Grading
  2. Layout and fagging of sprinkler heads and system
  3. Trenching
  4. Pipe and Wire placement
  5. Partial fill compaction of trenches

6. Control valve installation
  7. Electrical panel installation
  8. Irrigation controller installation and operation
  9. Mainline sustained pressure check
  10. Booster pump installation
  11. Backflow preventer installation
  12. Water Service installation and meter connection
- B. All overtime inspection charges incurred by City personnel shall be paid by the Contractor when inspection services are required outside of normal working hours. Work requiring inspection before or after the normal 8 hours of a normal working day or taking place on holidays, Saturdays and Sundays will be considered overtime inspection.
- C. A final inspection of the work shall be made by the City Inspector and Parks Division in the presence of the Contractor, at the time when all landscaping and irrigation work is completed. The Contractor shall provide 48 hours notification in advance of such inspection. Prior to the final inspection, the Contractor shall have prepared and transmitted to the City a record set of "As-Built" Plans of the landscaping and irrigation work. No final inspection will commence without the "As-Built" Plans.
- D. In the event that the Contractor schedules an inspection and has not completed the work that is to be inspected or made an effort to do so, the Contractor will be billed for the cost of the inspection and must remit the cost prior to final approval and inspection of the work.

#### **25-4.2 TESTING AND ADJUSTMENT**

- A. PVC main lines (upstream of control valves) shall be tested under a gauge pressure of 125 pounds per square inch (psi), said pressure to be maintained for a period of not less than 2 hours. PVC lateral lines (downstream of control valves) shall be tested under a gauge pressure of 75 psi, and pressure to be maintained for a period of not less than one hour. Such tests shall be performed prior to final backfill. All leaks shall be repaired and all defective materials replaced to the satisfaction of the Engineer, and the testing and repairs repeated until the system is approved.
- B. Sprinkler heads in proposed turf areas shall be installed one inch above grade and lowered to finish grade after the lawn is established. Any damage to lawn caused by lowering of the heads shall be repaired by the Contractor to the Engineer's satisfaction.
- C. After the installation of automatic controller, valves, sprinkler heads, drip

emitters and other equipment, the complete system shall be operated in the presence of the Engineer. Any defective or inoperative material shall be repaired or replaced to the satisfaction of the Engineer. The Contractor shall balance and adjust the various components of the system so the overall operation of the system is most efficient. This includes a synchronization of the controllers, adjustments to heads and emitters, and individual station adjustments on the controllers.

- D. When the irrigation system is completed, the Contractor, in the presence of the Engineer, shall perform a test to check the coverage of the system. The Contractor shall inform the City of any deviation from the plan required due to wind, planting, soil, or conditions that bear on proper coverage.
- E. The Contractor shall furnish all materials and labor required to correct any inadequacies of coverage due to site conditions or unauthorized deviations from the plans. If such corrections or additions are required in the sprinkler system, the Contractor shall make all adjustments and corrections without any extra cost to the City.

## **PART 5 MAINTENANCE AND CLOSE OUT**

### **25-5.1 MAINTENANCE**

- A. A ninety (90) day maintenance period will be required for all irrigation systems. This maintenance period will run concurrently with the landscape planting maintenance period. The maintenance period shall begin after all landscape construction activities have been completed, and upon receiving written approval of the work by the City.
- B. It is the Contractor's responsibility to continuously maintain and provide all necessary repairs until a written notice of final acceptance for maintenance is received from the City. The Contractor shall have the charge and care thereof and shall bear the risk of injury or damage to any part thereof by the action of the elements or from any other cause not the fault of the City. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work before final acceptance for maintenance.

### **25-5.2 COMPLETION**

- A. Upon completion of work, the Contractor shall provide to the City:
  - 1. Two additional keys to each enclosure and controller box.
  - 2. Two each of any specialized tools required for the operation and/or maintenance of each type of component installed in the system.
  - 3. Other items as specified in the plans and Specifications.

### **25-5.3                    SYSTEM GUARANTEE**

- A.        The entire irrigation system shall be guaranteed by the Contractor to give satisfactory service, and the Contractor shall guarantee the quality of material, equipment and workmanship, including settling of backfilled areas below finish grade, for a period of one year following the date of the filing of the Notice of Acceptance for all the work by the City.
  
- B.        If, within one year from the date of the filing of the Notice of Acceptance for all of the work, problems develop resulting from inferior or faulty materials or workmanship, or settlement occurs requiring adjustments in pipes, valves, emitters, heads, sod, or paving to the proper level of the permanent grades, the Contractor, as part of the work under his Contract, shall make all adjustments and corrections without extra cost to the City, including the complete restoration of ll damaged planting, paving, or other improvements of any kind.

### **25-5.4                    MEASUREMENT**

Landscape irrigation systems will be measured by the lump sum for the entire system, complete in every detail.